A COMPREHENSIVE ASSESSMENT OF ATLANTA'S STATUS AS A HIGH-TECHNOLOGY CLUSTER

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A COMPREHENSIVE ASSESSMENT OF ATLANTA'S STATUS AS A HIGH-TECHNOLOGY CLUSTER

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

This thesis addresses two questions to understand the current situation of technology in Atlanta: Is Atlanta an ideal location for a technology cluster to form? Does a true technology cluster exist in Atlanta?

According to cluster literature, there are seven characteristics required for emerging clusters: a high-quality, powerful research university; a skilled labor pool; funding (R&D, venture capital, etc.); favorable policies; linkages; certain city characteristics; and luck. There also are several somewhat-vague characteristics that show success in a cluster. Among these are agglomeration, innovation (where funding and employment are two measures of innovation), and growth.

In order to provide a comprehensive assessment of the answers to the two questions, a mixture of summary statistics, shallow case studies, previous analysis, and comparisons of Atlanta with other clusters are blended together to assess Atlanta's performance on each of the characteristics outlined in theory. Where possible, more than one of these measures are used.

Of the seven necessary characteristics of cluster creation set out by theory, Atlanta seems to have achieved a passing grade regarding research university, labor pool, and city characteristics, but has a failing grade on policy and linkages. One interesting finding is that Atlanta receives a strong amount of venture capital investment in start-ups but is lacking in later stage companies.

Atlanta's success as a cluster is dubious. It has proven somewhat successful in start-ups and in the so-called "Level II" technology companies that have lower levels of technology-oriented jobs and that tend to be more manufacturing focused. It is also possible that a technology cluster is forming in Atlanta, but that it is still in its

infancy.

With regard to policy, it is recommended that Atlanta gain certain policies that will allow for the characteristics of cluster formation (particularly investment and linkages–since those are the areas where Atlanta is or possibly is lacking) and replace policies that will hinder the growth of technology and investment in the technology industries.

CHAPTER I

INTRODUCTION

This thesis addresses two questions to understand the current situation of technology in Atlanta: Is Atlanta an ideal location for a technology cluster to form? Does a true technology cluster exist in Atlanta? We will then use the answers to these questions to better understand both theory and the policy that should be undertaken in Atlanta with respect to technology the growth of and support for technology.

These questions have been posed based on my previous research of Georgia. This research points out the many indicators suggesting that Georgia should be a vibrant technology cluster. The high-tech industry is intended to be an essential sector for growth in Georgia. Georgia is highly ranked in terms of venture financing per capita in startups. The technology sector has long been promoted in Georgia by state agencies, and Georgia Tech and Emory yield thousands of graduates with specialties in science and technology every year, so one would expect Georgia to be ripe in strong, high revenue, very innovative technology companies. A brochure published by the Georgia Research Alliance states that "our state is fast gaining a national reputation for turning scientific discoveries into economic gains," [13, 2] showing the high opinion many people have regarding technology in Georgia.

Also, those in the industry present Georgia as a center of high technology. Georgia has several programs focusing on the development of technology and technology companies in Georgia that "are helping to make Georgia synonymous with Technology." The Georgia Centers for Innovation fosters growth and facilitates collaboration between Georgia innovation players–innovators, businesses, and investors–by providing access to university-level research and development, training. The Georgia Tech Enterprise Innovation Institute provides commercialization services, industry services, entrepreneur services, community policy and research services, and "helps companies, entrepreneurs, economic developers and communities improve their competitiveness through the application of science, technology and innovation." The Technology Association of Georgia (TAG) "is dedicated to the promotion and economic advancement of the states technology industry and provides leadership in driving initiatives in the areas of policy, capital, education and giving. TAG also brings the technology community together through events, initiative programs and networking opportunities."

Based on all of these points one would expect Georgia (and Atlanta specifically) to be considered a thriving high-tech cluster. However, the research also shows another side of the story.

There are very few large Georgia technology companies, and only two truly notable and innovative technology companies have come out of Georgia (Scientific Atlanta and MSA), both of which have since been purchased by non-Georgia companies (Cisco Systems and Dun & Bradstreet, respectively.)

Also, many of the most-promising young companies are moving out of state or being purchased by out-of-state companies.

This paper seeks to systematically determine both whether or not Atlanta has what it takes to be a technology cluster and whether or not it has indeed become one. Recommendations for policy and future research will be built around the results depending upon how they correspond with theory.

CHAPTER II

CLUSTER THEORY

2.1 Core Cluster Theory and Literature

Marshall (1961 [1890]) was the pioneer of cluster literature, referring to "agglomeration economies", economies of scale resulting from a locational externality. Since Marshall, Porter argued that a nation's success depends on four factors: factor conditions such as skilled labor and infrastructure necessary to compete in an industry; home demand for the industry's product or service (demand conditions); related and supporting industries such as suppliers; and firm strategy, structure, and rivalry: the conditions governing how companies are created, organized, and managed, as well as the nature of domestic rivalry [32]. Porter also argued that the intensity of interaction within these is enhanced if the relevant firms are also clustered, and he says that a nations most globally competitive industries are likely clustered within that nation [28].

Lawson and Lorenz (1999) provide a nice summary of the industrial districts literature of the 1980's as well as a nice summary of the organizational learning literature. The industrial districts literature stated that the technological dynamism of industrial districts depended on the co-operation/competition balance of the firms in them. It said cooperation is the provision of collective goods or services (training, education, R&D, medical care, unemployment insurance) and/or adherence to norms of reciprocity (sharing information, subcontracting to less-successful competitors, and refraining from wage and labor competition.) The organizational learning literature stated that learning depends on some knowledge being shared among the members of the organization. This learning is mostly tacit and is embodied in organizational routines and procedures. Generating new knowledge within the organization depends on combining diverse knowledge. Firms may find it difficult to make effective use of new knowledge because they face resistance to making changes in the organizational routines and procedures in which knowledge is embodied. Lawson and Lorenz also provided a number of definitions for terms commonly used in this literature. A "core competence or capability" is something an organization is able to do better than others. A "dynamic capability" is the ability of a firm to renew, augment, and adapt its core competencies over time. "Organizational learning" refers to the process of generating knowledge (technical, organizational, marketing, etc.)

2.2 Cluster Models

Martin and Sunley (2003) provide a critique of Porter, stating that the cluster notion should be more "cautious and circumspect" particularly with respect to policy and stating that Porter's model makes interpretation of observations difficult and potentially contradictory. They also critique Gordon and McCann (2000)'s three cluster models ("pure agglomeration economies", "industrial complex", and "social-network") because these models are ideal types and as such not realistic, and because the authors did not specify under what circumstances one model is more applicable than another.

Florida and Kenney (1990) outline two theories regarding the rapid growth of both Silicon Valley and Route 128. The first theory is that small firms are somehow better suited to new high-technology fields than are big ones. The second theory states that networks or communities of small firms are more effective than are large integrated companies. The argument is that networks of small firms have close relationships, shared trust, and intense cooperation in the development and production of new products. The authors then go on to state that these regions suffer severe competition that seriously limits the ability of small firms to cooperate with each other and that the model of organization in these regions cannot be the solution to heightened global competition because it generates tough internal competition and serious industrial fragmentation. This leads to a few questions: To what extent does the firms' insistence on an increase in profits at the expense of their collaborators affect the positive regional effects many other authors have mentioned? Also how does this situation compare with one of standard non-clustered competition?

Markusen (1996) outlines the "new industrial district" as well as outlining three additional types of districts, the "hub-and-spoke", "satellite platform", and "state-anchored" districts. The new industrial district features a business structure involving small, locally owned firms. The hub-and-spoke district has a regional structure that revolves around one or ore major corporations in one or more industries. The satellite industrial platform mostly consists of branch plants of absent multinational corporations; and the state-centered district has a major government tenant anchoring the regional economy.

She also discusses the "stickiness" of industrial districts. This concept implies both an ability to attract as well as to keep, and as such applies to new and established regions both. Sticky places are normatively "better" if they ensure average or better-than-average growth for a region as a whole over time, insulate a region from the job loss and firm failures of short-to-intermediate-term business or political spending cycles, provide relatively good jobs and prevent undue concentration of wealth and ownership, foster worker representation and participation in firm decision making, and encourage participation and tolerate contestation in regional policies [26, 296].

She also states that the success of sticky places cannot be studied by focusing only on local institutions and behaviors because their companies, workers, and institutions are embedded in external relationships. Regional economic developers should assess their existing structures and design their strategy around them, instead of focusing on small-firm networking within the region, as improving relationships and networks that reach outside the region can be more productive [26, 309-10]. This holds special relevance to Atlanta, since–as will be discussed in Section 5.3–Atlanta is weak in venture capitalist firms.

2.3 Requirements for Emerging Clusters

There are many different lists of criteria regarding clusters. It seems every author that touches on the subject provides a different list. Orsenigo [1, 205-206] provides four "ingredients of innovative clusters", and O'Mara [31, 227-230] discovers four "lessons" for those attempting to create a cluster. Some of these criteria are factors that can lead to the emergence of a cluster, while others are simply characteristics of developed clusters. I will provide a list of these criteria and then since these lists all overlap to some degree, I will also provide my own list that will be a succinct summary of these lists of cluster criteria.

Orsenigo's "ingredients of innovative clusters" [1, 205-206] are: the scientific base; entrepreneurship, VC, and a favorable intellectual property regime; linkages with large firms and other industries; and institutions, policies, and other infrastructures that support and promote entrepreneurship. Orsenigo also outlines some criteria mentioned in previous literature, first for emerging clusters: unexploited technological and market opportunities, highly educated skilled labor, firm- and market-building capabilities by pioneering firms, connections to markets, and luck (Bresnahan, Gambardella, and Saxenian (2001); and then for clusters that have already been formed: the presence of supporting instutinsions such as VC's and the diffusion of particular social attitudes such as entrepreneurship. O'Mara's four "lessons" for those trying to build the "next Silicon Valley" are: you need a lot of money, a powerful university, control over land in the right location, and to make high-tech development the end, not the means [31, 227-230]. In his 1989 article, Smilor provides three themes of "technopolis development": the need for a coordinated approach to high-technology company development, the presence of a high-quality research university, and the importance of a network of influencers or "executive champions" [36, 49-50].

As well as defining the five features of accomplished regional economies, Cooke also developed a list of conditions and criteria for regional innovation systems' potential. The infrastructural characteristics that improve potential are: autonomous taxing and spending, regional private finance, policy influence on infrastructure, and regional university-industry strategy. The superstructural characteristics that he claims improve potential are: cooperative culture, interactive learning, associative consensus, harmonious labor relations, worker mentoring, externalization, interactive innovation, and an organizational dimension that as policy is inclusive, monitoring, consultative, and networking [6, 13-15]. Later in the paper, we will look at these five features and this list of conditions and criteria to discover whether Atlanta indeed has these characteristics and whether it is a reasonable environment in which to expect a technology cluster to develop.

When all these lists that are compared, the factors that stand out the most are a high-quality, powerful research university; an educated workforce; funding; favorable policies; infrastructure; linkages; city characteristics; and luck. A research university seems to be the easiest to agree on: O'Mara, Smilor, and Orsenigo all mention it as a necessity. Bresnahan, Gambardella, and Saxenian refer to two important criteria: a skilled labor pool and luck. O'Mara points out the need for funding, be it R&D, venture capital, or other funding. A variety of authors provide policies they believe are favorable to the creation of clusters: Orsenigo insists upon policies that promote entrepreneurship as well as the existence of a favorable intellectual property regime; O'Mara states that policies that make high-tech development the end, not the means are necessary; while Smilor finds that a coordinated approach to high-technology company development is necessary. Orsenigo and Smilor both find that linkages are necessary.

A high-quality, powerful research university
A skilled labor pool
Funding (R&D, venture capital, etc.)
Favorable policies
Linkages
City characteristics
Luck

Figure 1: Required characteristics for clusters.

As a final criterion, several authors provide a variety of city characteristics that they believe to be essential. Smilor (1989) mentions quality of life as being an important characteristic. O'Mara discusses social issues of a region and the role they play. Florida (2002) states that having abundant high-quality amenities and experiences, an openness to diversity of all kinds, and above all else the opportunity to validate their identities as creative people [12, 218] is the only way to draw a sufficient creative talent pool for a cluster to thrive. These required characteristics for emerging clusters are discussed further in detail both generally and with respect to Atlanta in Chapter 5.

2.4 Characteristics of Successful Clusters

Cooke (2002) outlined five features of accomplished regional economies: agglomeration economies, institutional learning, associative governance, proximity capital, and interactive innovation. The concept of agglomeration economies goes back to Marshall in the 19th century. In summary, it refers to a concentration of producers that support local suppliers, generating localized skill pools and knowledge spillovers [27]. Institutional learning refers to the institutional creation of norms and conventions, encouraging certain practices and trustful relationships among firms and organizations. Associative governance refers to regional administrative bodies that are interactive and inclusive regarding other bodies such as business associations or chambers of commerce that also affect regional innovation. The concept of proximity capital varies in definition, but generally refers to infrastructure such as road, rail, airport, and telecommunications. Interactive innovation refers to firms' opportunities to access or test knowledge due to rich innovation infrastructure and routine institutional learning.

Several measures along these lines (particularly regarding agglomeration and innovation) will be used in Chapter 6 to determine whether Atlanta is a successful cluster.

2.5 Importance and Benefits of Clusters

This quote by Annalee Saxenian summarizes the benefits of clusters:

> Technology firms, in particular, are highly international. However, the most strategic relationships are often local because of the importance of timeliness and face-to-face communication for rapid product development. Moreover, nonlocal suppliers succeeded in part by integrating into regional economies that specialize in similar lines of business. Paradoxically, the creation of regional clusters and the globalization of production go hand in hand, as firms reinforce the dynamism of their own localities by linking them to similar regional clusters elsewhere [34, 5].

Long-time employee of DEC and founder of a technology company, Jeffrey Kalb, when interviewed by Saxenian stated that "Time-to-market is right behind cash in your priorities as a start-up. When things are right down the street, decisions get made quickly. It's not one thing, but if you spend lots of time on airplanes and on the phone, playing phone tag, you can get an overall 20-30 percent slowdown in time-to-market" [34, x].

2.6 Costs Associated with Clustering

Martin and Sunley agree with Perry (1999) that local and regional specialization has its costs (e.g. technological isomorphism, labour cost inflation, inflation of land and housing costs, widening of income disparities, over-specialization, institutional and industrial lock-in, and local congestion and environmental pressure) [28, 27]. These costs will be considered in detail regarding the case of Atlanta later in the paper and will be analyzed both as possible costs currently existing as well as potential future costs due to clustering. Martin and Sunley argue that it is more advisable for local and regional authorities to encourage productivity improvements in all local firms without committing to a cluster.

CHAPTER III

BACKGROUND INFORMATION

3.1 Renowned Technology Clusters

In the United States, there are two large, well-known technology clusters. Silicon Valley is the most famous, but there is another, almost equal in size (but culturally and historically very different) in Massachusetts located along Route 128, a partial beltway around Boston. During the 1970s, Silicon Valley and Route 128 were the world's leaders in electronic innovation. Both for a time met hard times, however, and in the 1980s Silicon Valley lost business to Japan while Route 128's minicomputers lost popularity to workstations and personal computers. Then in the 1980s, Silicon Valley regained its status, but Route 128 did not fare as well [34, 1-2].

There also are a number of smaller technology clusters, generally focused around a research university and thus often occurring in college towns. Of these, the most focus will be placed on Austin, Texas (University of Texas) and the Research Triangle of North Carolina connecting Raleigh, Durham, and Chapel Hill (NC State, Duke, and the University of North Carolina), as well as the possible cluster in Atlanta, Georgia (Georgia Tech). Some mention may also be made to other technology clusters in the South for purposes of comparison.

3.1.1 Route 128

During the war and postwar years, MIT focused on relationships with government agencies and established electronics producers, and became the nation's leader in military research. Sources of capital began to supplement continued government funding. Early on, Route 128 was billed "the road to nowhere," but as it grew (by 1961–ten years after its completion–it had boomed, featuring 169 businesses with

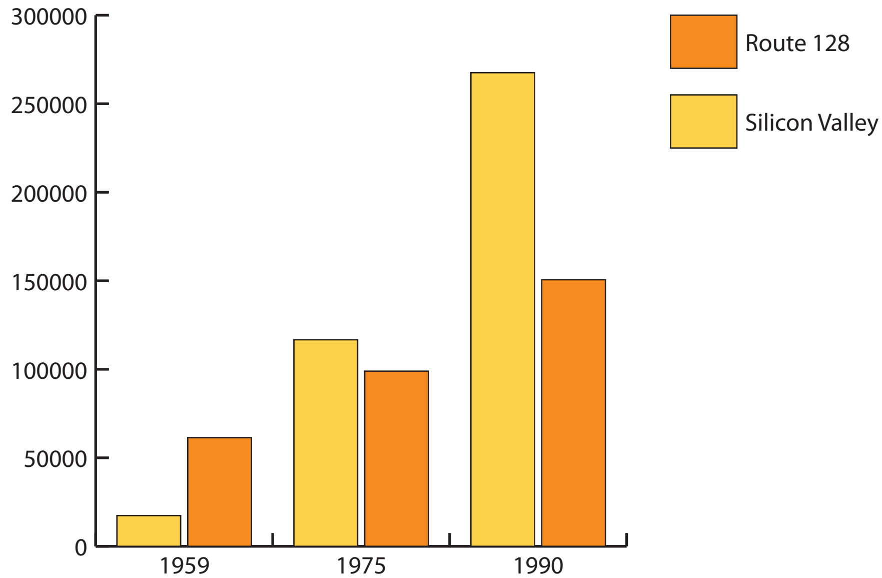

Figure 2: High technology employment in Route 128 and Silicon Valley [34, 208].

24,000 employees), local boosters renamed it "America's Technology Highway." By 1970, Route 128 was the country's leader in electronics innovation.

In the early 1970s, the Vietnam war and the space race had slowed, causing a loss of close to 30,000 defense-related jobs. Companies lacked the flexibility to turn their defense knowledge into products profitable in civilian markets. Finally the minicomputer industry grew, and R128 rebounded somewhat in the late 1970s and early 1980s [34, 12-18]. However, this success was short-lived, and "by the end of the 1980s, Route 128 producers had ceded their longstanding dominance in computer production to Silicon Valley" [34, 2]. Figure 2 shows how Silicon Valley has seen much more rapid growth than Route 128. The figure does not show it, but in recent years, high technology employment in Route 128 has actually decreased.

Technology leaders in Route 128 did not have the public profile or sense of community of those in Silicon Valley, but instead tended to focus on modesty and not on status or the material aspects of it. Stability and company loyalty were considered more important than experimentation and risk-taking. Moving up the corporate ladder was favored over leaving a large company to start or join a new firm. Risk-avoidance was also a part of the culture [34, 62-63]. "There were far fewer opportunities for entrepreneurial learning on Route 128 than in Silicon Valley. One study concluded that the typical Route 128 entrepreneur in this period had only one prior work experience before founding a start-up, and that a large percentage of the region's firms were direct MIT spin-offs whose founders lacked industrial experience altogether. In Silicon Valley, by contrast, most entrepreneurs had previously worked at several different firms" [34, 64].

3.1.2 Silicon Valley

In the 1930s and early 1940s, entrepreneurs and technologists that had been associated with the San Francisco Peninsula's electronics hobbyist community specialized in manufacturing power-grid tubes, while another community in the Peninsula focused on microwave tubes and a third on semiconductors in the late 1950s and 1960s. Because of these groups' technological and social innovations, they were hired by the military during World War II and the Cold War.

Then when the Department of Defense cut back on component expenditures and changed its procurement policies in the 1960s, firms adapted their products and innovations for use in the commercial sector.

In the 1960s and early 1970s, new firms–many spin-offs of existing Silicon Valley firms–made silicon electronics a ubiquitous technology and completed the progression of Silicon Valley into a major technological and commercial center [22, 6-12].

3.1.3 Differences between Route 128 and Silicon Valley

During the war and postwar years, MIT focused on relationships with government agencies and established electronics producers, while Stanford promoted the formation of new technology companies and cooperation with local industry [12].

Route 128 is structured very differently than Silicon Valley. Route 128 companies are usually large and vertically integrated, while Silicon Valley companies are more specialized, resulting in better opportunities for small companies. The culture of Silicon Valley is also different than that of Route 128, and it is a culture of change and rapidity of decisions and movement. The different infrastructure plays a role in this by allowing for a faster velocity of information and the easier formation of relationships [34, ix-xi]. The culture of Route 128 is very resistant to change and is a culture of secrecy, corporate loyalty, stability, and self-reliance [34, 3].

3.2 The South

While the literature overflows about Silicon Valley and even Route 128 as technology clusters, as well as providing a multitude of articles regarding other types of clusters, not much has been said about the South. Even though the South has at least three developing technology regions, only a handful of articles are available that specifically address them. Much of the information regarding these clusters must be found outside the traditional academic journals, in places such as practitioner journals and economic development reports by government agencies and not-for-profit organizations.

The South also tends to face issues that other regions do not. The region often has difficulties in drawing professionals and other experienced employees or companies to it because of perceptions regarding the South. The South is often seen as "backwards." This particularly has been true historically, and issues of race and inequality can often be a major hurdle that must be worked around [31].

3.2.1 Austin, Texas

Smilor, et al use the case of Austin to propose the conceptual framework of a "technopolis wheel" composed of seven segments as well as linkages between those segments, and through this process they explain much of what has gone on behind the scenes in order to cause Austin to become the technology center it is today. The seven segments that they claim have led to the development of Austin, Texas as a "technopolis" are: the research university, large technology companies, small technology companies, state government, local government, federal government, and support groups. The linkages that connect these seven segments they refer to as "key individuals" or "influencers" [36, 51].

In the early 80's, "Austin made headlines in the New York Times, the Wall Street Journal, and the world press as the next great 'Silicon Valley.' Nicknamed 'Silicon Prairie,' 'Silicon Gulch,' and 'Silicon Hills,' the area experienced an unprecedented wave of enthusiasm because of the perception that it had suddenly become a major technology center" [36, 52]. In the mid-80's, Texas suffered economic decline and recession because of a sudden decrease in oil prices as well as a decrease in farm and beef prices. In the late 80's, Texas increased funding for higher education and research.

The University of Texas, Austin has played a key role in the development of Austin as a technopolis. Endowments made a significant difference in attracting researchers and thus funds and exceptional grad students. Of 103 small- and medium-size technology-based comps in 1986, 53 indicated a tie of their origin to UT-Austin. However, it is not only the University that makes a difference in cluster development. Funding and the government also have a great deal to do with universities' impact. This can be seen in the case of Austin because "as state allocations for higher education increased [...], the perception of the development of Austin as a technopolis outside the state increased proportionately as well. On the other hand, as the State of Texas began to cut back its funding to higher education in 1983, the perception of Austin as a developing technopolis declined and the perception of retrenchment in the university began to emerge (Gibson and Rogers 1988)" [36, 54-55].

Federal and local government also played a part in helping Austin become a "technopolis". The federal government impacted Austin by developing Bergstrom Air Force Base and by funding R&D at Balcones Research Park at UT-Austin. The local government has also played a role by focusing on quality of life, trying to make Austin more appealing and affordable than other technology centers.

The support group segment of the proposed "wheel" can been seen in Austin through venture capital growth. In 1980, Austin had virtually no VC money, but by 1986, the city had approximately $80 million and five firms. This growth was due to changes in federal tax laws pertaining to capital gains as well as to the perception of Austin as an emerging tech center. However, most VC investments even by Austin VC's continued to be made outside the region. Also, the private sector has had an impact in Austin. A few large firms (IBM, MCC, Tracor) have located within Austin and produced many spin-outs, and these spin-out firms have also produced their own spin-outs. This is supplemented by the University, which also produces many spin outs, as well as attracting firms from outside the region because of Austin's access to university resources (especially talent) and the quality of life and employment rate.

Youtie and Shapira (forthcoming) also outline Austin's growth as an innovation hub, stating that it's approach "reflects planned bottom-up efforts of the local chamber of commerce in combination with city government and the University of Texas at Austin" [40, 14]. They also point out the importance of MCC, Sematech, and Dell, branch facilities of AMD and 3M, and the University of Texas' high-technology incubator.

3.2.2 Richardson, Texas

Richardson, Texas is also considered a southern industrial district, with over 600 high-technology firms and 70,000 employees [25]. Lyons claims that this high-technology industrial district formed in Richardson because of Texas Instruments and Collins Radio, spin-offs from those two companies, and because of downsizing and the resultant purchase of companies in Richardson by international companies when the United States' telecommunications market opened in the early 1980's.

3.2.3 The Research Triangle

The Research Triangle–the region of North Carolina containing Raleigh, Durham, and Chapel Hill, as well as Duke University, North Carolina State University, and the University of North Carolina at Chapel Hill–is an important southern high-technology region. Youtie and Shapira (forthcoming) outline its history, stating that the area and its initiative was influenced by the post-World War II concept of high-technology research parks. At the time, the region was predominantly rural, and multiple medium-sized cities were the basis of this initiative. In the 1960's, R&D branch facilities of IBM and the National Institute of Environmental Health Sciences located in the Research Triangle. This led to the growth of the area as branches of many IT and biopharmaceutical firms followed these large branches, and eventually smaller technology startups joined them [40, 14].

3.3 Atlanta, Georgia

3.3.1 History

Although Georgia Tech was founded in 1885, local and regional legislators did not focus on providing it with adequate funding until the 1940s, and it remained far behind other universities both regionally and locally. Since 1944, however, several state-funded programs both inside and outside Georgia Tech "such as expanded graduate programs at Georgia Tech (1946), the Georgia Science and Technology Commission (1965), the Advanced Technology Development Center (1980), the Georgia Research Alliance (1990), and the Yamacraw Initiative (1999) have supported the growth of technology industry, with Atlanta cast in a central role" [5, 229]. Also in the 1940s, the Bell Aircraft Company established a bomber plant in Marietta because the region had many unemployed workers and elected officials and business leaders with a "can do" spirit [5, 48-49].

In the 1960s, Mayor Ivan Allen, Jr. helped Atlanta to see more economic growth and immigration than other regions. Atlanta attempted to make itself more attractive than other southern cities by embracing social, political, and demographic changes [5, 9]. "Throughout its history Atlanta has taken a pragmatic position with respect to dealing with race-related social issues, opting for actions that were 'pro-business' " [5, 225].

In the 1970s, Georgia Tech president Joseph Pettit helped GT's Engineering Experiment Station research funding to grow eleven-fold, particularly through defense-related R&D [5, 243], and in 1979, Georgia's governor George Busbee and Georgia Tech created the Advanced Technology Development Center (ATDC), an incubator for technology firms [5, 9].

During the 1970s and 1980s, Georgia Tech became known as the nexus of new technology initiatives, and Georgia Tech's role in the economic development of the city became a strong focus for Atlanta's governors [5, 252]. As a result, in the 1980s, Atlanta developed the capacity to attract entrepreneurs through ATDC, local sources of venture capital, and established tech firms [5, 210], and in 1998, the Metro Atlanta Chamber of Commerce began "Industries of the Mind", a five-year campaign to recruit and lead to the creation of new technology firms.

1895	Plant Telecommunications established
1953	GT Engineering Experiment Station established in Atlanta
1972	Joe Petit moves to GT Research Enterprise
1975	First microcomputer store east of the Mississippi opens in Atlanta, next to Disco Kroger
1975	First microcomputer developed by Georgian Ed Roberts–MITS
1976	First national gathering of MITS reseller/dealers at Tower Place Hotel
1977	First hard drive interface for microcomputer (Altair) developed in Atlanta and bought by Pertec (Philips)
1978	First accounting software for microcomputers (Peachtree)
1981	ATDC Launched–Ron White
1983	The Weather Channel moves to Atlanta–John Coleman (Landmark Comm.)
1983/84	ATDI became BETA, became TAG
1984	ATDF founded–Danny Ross, Ron White
1990	Georgia Research Alliance founded
1994	Alliance Technology Ventures founded
1995	Manhattan & Assoc. moves to Atlanta
1996	Atlanta hosts the Olympic Games
1996	Webgrrls founded by Gloria Moore
1998	Women in Technology International (WITI) founded by Gloria Moore
1999	The Athens New Media Synergy Center Founded
2001	Green Guard Environmental Institute founded
2002	Athens Area Technology Council formed
2002	High Tech Partners Seed Fund founded
2003	Creation of Savannah Maritime Logistics Innovation Center

Figure 3: Timeline of historical technology-related events in Georgia [2]

In 2003, a timeline of technology in Georgia was assembled by Char Baxter Communications, LLC and presented at the Georgia Technology Celebration. This document contains both a timeline of events as well as a chart of technology companies that have been considered an essential part of the growth of technology in Georgia and the children of those companies. The timeline included in the document is intended to show "historical events [that] represent a sampling of significant community events, company relocations, technology innovations, and government programs that have occurred during our history" [2] and can be seen in Figure 3.

3.3.2 Atlanta's Attempt at Becoming a Cluster

As well as providing a synopsis of Atlanta's timeline as a technology cluster, Combes (2002) provides some insight into why Atlanta has not had success as a cluster comparable to that of Silicon Valley and Route 128. He points to the late development of Georgia Tech compared with that of Stanford and MIT, the lack of specialization in a particular technology, the decision of entrepreneurs to sell out to larger firms, and the lack of a cooperative network of firms (although this last he also cites as a potential advantage.)

Combes states that "while Georgia Tech lags behind Stanford and MIT in research funding and patent production, both these universities had well-developed graduate and research programs in the 1920s [...] when Georgia Tech was a financially struggling undergraduate college. During World War II, MIT and, to a lesser extent, Stanford received significant federal R&D funding, while Georgia Tech had only one small contract in [its Engineering Experiment Station]" [5, 257-258].

Combes also pointed out that Atlanta lacks the specialization of Silicon Valley and Route 128, saying that "rather, Atlanta has developed a diverse set of somewhat unrelated technology firms, ranging from advanced aircraft to software to specialized laboratory instruments" [5, 9-10].

O'Mara (2004) ponders the question "Why didn't Atlanta become a Southern high-tech capital like Research Triangle Park or Austin?" She states that Atlanta had many of the factors needed for a high-tech region to be formed, such as rapid growth, low-density landscapes, upper-middle-class communities, and the creation of research parks. She remarks that the way "cities of knowledge" grow relies on state institutions taking an active and early interest in creating agglomerations of technology centered around a university. She states that while officials in Georgia who dealt with the funding of Georgia Tech were more focused on the whole state, not Atlanta specifically. O'Mara also points out issues of race and perceptions that may have played a part in Atlanta's not becoming as strong of a high-tech center as the Research Triangle or Austin.

CHAPTER IV

METHOD

This thesis addresses two questions to understand the current situation of technology in Atlanta: Is Atlanta an ideal location for a technology cluster to form? Does a true technology cluster exist in Atlanta?

Various data sources will be consulted and a variety of methods will be used in order to determine where Atlanta stands in terms of both the characteristics required for a cluster (outlined in Section 2.3) and the characteristics that show Atlanta to be a successful cluster (outlined in Section 2.4). Chapter 5 will address characteristics required for cluster creation, and Chapter 6 will address the characteristics of successful clusters.

If it is found that Atlanta is ideal to become a cluster and has become one, theory has been supported by this case. If it is ideal to become a cluster and has not become one, we will attempt to ascertain why and provide policy possibilities that may improve its cluster possibilities. If it is not ideal to become a cluster, yet has become one, theory will be reconsidered, as the case of Atlanta does not fit the current theory regarding the conditions necessary for a cluster to form. Finally, if Atlanta is not an ideal location for a technology cluster, and no cluster has formed, theory has been supported. Also in this instance, policy prescriptions will be made along the lines of the current theory regarding clusters and cluster formation. These various aspects will be addressed in Chapter 7.

Once these two things have been determined using quantitative and qualitative measures, we will have a better idea of where we stand and then will be free to add in whatever other aspects are at that point deemed important, such as more in-depth network analysis, a more in-depth comparison with other more established technology clusters (Silicon Valley, Route 128, Austin, and the Research Triangle when available), look deeper into why companies leave Georgia, etc., but some of these questions may be answered by the simpler analysis (e.g. if Georgia is missing a necessary criterion, that might be a reason for firm flight, although testing this is always also an option).

Whatever data are available will be analyzed, resulting in a mixture of summary statistics, shallow case studies, previous analysis by technology executives around the country, and comparisons of Atlanta with other technology clusters. Where possible, more than one of these measures will be used in an attempt to determine how successful Atlanta has proven to be.

CHAPTER V

REQUIRED CHARACTERISTICS FOR CLUSTERS

5.1 Research University

O'Mara provides a number of lessons for those trying to build the "next Silicon Valley." Of these, lesson two states that a powerful research university with resources and the willingness to embrace corporate partnerships as well as the institutional ability to play a leading role in local economic development is needed in order for a "city of knowledge" to form [31, 227].

Smilor's article about university spin-outs also places importance on the need for a research university in a cluster. His research finds that the link between spin-out activity and university training in a technical field is strong whether the university educates or inspires the spin-out founder or simply recruits him or her to the area and that the university is also important in promoting the continued development of the spin-out as it provides additional university-trained graduates that provide these businesses with educated labor and new ideas. He also references theory stating that universities are beneficial for other reasons, claiming that "the liberal arts, cultural and entertainment amenities sustained by the university, are important to attracting potential entrepreneurs to an area as well as encouraging them to remain in the area when they begin and expand their spin-out companies (Cooper 1972; Gibson and Smilor 1988)" [35]. Orsenigo also refers to spin-offs, claiming that the main cause behind the spatial concentration of innovative activities is spin-offs from universities and research centers [1].

When pondering the problems of losing faculty to spin offs, Smilor notes that even when valuable faculty are lost, the spin-out can be considered positive, as it

Table 1: R&D and grad student figures, select universities.

	R&D Expenditure, 2006		S&E and Health Grad Students, 2004	
University	Ranking	Thousands	Ranking	Number
Stanford	8	679,196	9	5,018
Duke	10	657,080	71	1,615
MIT	14	600,748	1	5,839
UNC-Chapel Hill	31	443,790	26	3,060
Georgia Tech	32	440,898	12	4,415
UT-Austin	33	431,398	18	3,771
NC State	51	330,936	23	3,389

provides a future research and financial source for the university and provides jobs for university graduates [35].

In the *U.S. News & World Report* for 2007, Georgia Institute of Technology (Georgia Tech) ranked seventh among all public universities and thirty-fifth among all universities for undergraduates in the United States. The College of Engineering's graduate program is ranked fourth, and the College of Engineering's undergraduate program is ranked fifth. Also, nine of the undergraduate engineering programs are ranked in the national top ten, as well as eight of the graduate engineering programs ranking in the national top ten.

While Georgia Tech and the other southern technology universities began their development much later than technology universities in other regions (for example, in the 1950s, Georgia Tech awarded 66 Ph.D.s in Engineering, Mathematics, Physics, Chemistry, and Geo-Sciences, compared to MIT's 1,521 and Stanford's 580 [5, 85]), it has been quite successful in shrinking that gap, as can be seen in Table 1.

Georgia Tech focuses on integrating with Atlanta and the region through the means of programs such as its Advanced Technology Development Center (ATDC), a technology incubator for early stage companies; the Georgia Tech Research Institute (GTRI), a large segment of whose work focuses specifically on Georgia companies and government entities; VentureLab, an initiative that provides assistance to people affiliated with Georgia Tech that are interested in forming their own startup companies around technologies they have developed while with Georgia Tech; and the Enterprise Innovation Institute (EII, formerly the Economic Development Institute), a service organization focusing on business and economic development across the state of Georgia.

This policy of focusing on integration and the economic development of the region has been referenced in a report by the Southern Growth Policies Board:

> "Virtually every combination of industry relationship or economic development activity can be found at Georgia Tech, and in a very real sense the school is an operating partner with Georgia state government in the implementation and management of a variety of technology-focused initiatives. Perhaps more than any other research university in North America, economic development is an integral, critical component of the mission of the Georgia Institute of Technology" (Tornatzky et al 2002, [38, 28].

When comparing it with the Research Triangle and UT-Austin, Youtie and Shapira (forthcoming) noted that Georgia Tech differed by having a multi-faceted networked statewide approach with no formal plan, focusing on the attraction of human capital instead of attracting external R&D, building its strategy around university startups instead of firm relocation, and encouraging policymakers and businessmen to look to Georgia Tech for innovation-based regional development [40, 37-39].

Youtie and Shapira also refer to Georgia Tech as a "knowledge hub" and an " 'animateur' of development", stating that through the initiatives listed above as well as others, Georgia Tech imparts both tacit and codified knowledge to other stakeholders, and that the problems with the emergence of a strong innovation system in Georgia lie in the introduction of further research nodes, K-12 education, incentives and capabilities for innovation, and private R&D [40, 40-42].

Georgia Tech certainly seems to be a research university paralleling the universities

Table 2: Degrees awarded by Georgia Tech, by college, AY07.

	Bachelor's	Master's	Ph.D.	**Total**
College of Computing	188	144	34	366
College of Engineering	1,444	754	360	2,558
College of Science	219	115	73	407
Subtotal	1,851	1,013	467	3,331
Other Colleges	662	284	25	971
Total	2,513	1,297	492	4,302

other technology clusters are based around. The Research Triangle has the benefit of having three excellent universities, while most other technology clusters only have one strong university. Although Georgia Tech is the main university associated with the growth and improvement of technology in Georgia, the support of other universities in the area (Emory, the University of Georgia, and others) is also beneficial for Atlanta as a technology cluster. Georgia Tech somewhat lacks in R&D expenditures compared with Stanford, Duke, and MIT, but it does parallel UT-Austin and UNC-Chapel Hill (Table 1).

5.2 Labor Pool

Bresnahan, Gambardella, and Saxenian point to the importance of a highly skilled labor pool, stating that "all our regional stories point to the importance of highly skilled labor as a precondition for the growth of an ICT-based entrepreneurial cluster–Taiwan, Ireland, India and certainly Israel" [37, 846]. However, they also state that this does not point to any particular source of this labor pool as being ideal. They show a number of different methods of procuring this labor pool beyond the conventional wisdom that higher education is the only way to gain this labor: contract research for government and defense, training by established firms, or labor supply from outside the region [37, 846-847].

Georgia Tech and Emory combined award thousands of engineering, science, and computing degrees every year. Georgia Tech's numbers are presented in Table 2. As

Table 3: The "Young and Restless."

Ranking of 50 largest metropolitan areas, 1990-2000	Atlanta [8]	Austin [8]	Boston [7]	San Francisco [8]
Metropolitan Growth	4	2	39	?
Young Adult Population	2	1	23	?
Change in Young Adult Population	4	2	39	?
Change in College Educated Population	5	3	40	?
College Educated Population	9	6	2	3
Change in Market Share of College Educated Pop	1	5	48	2
Net Domestic Migration Rates	3	11	31	?

well as graduates from its own universities (who may or may not stay within the state), Atlanta attracts a group often referred to as "the young and restless"–college educated 25- to 34-year-olds–a group the literature finds to be essential because "The best time to attract the population that will provide the human capital for a region's economic future is when they are 'Young & Restless.' " [29, 7]. This claim is made based on the logic that this segment of the population is the hardest-working and most mobile. They tend to be finding new careers and making roots. In short, during this age period is the best time for a region to attract these workers and encourage them to work in particular industries [8]. This relates to Richard Florida's "creative class" argument because as stated in a Metro Atlanta Chamber of Commerce report: "the greatest opportunity to attract and retain these workers [the 'creative class'] is when they are young and mobile" [8, 5].

"Although metro Atlanta ranks eighth in the overall number of 25- to 34-year-olds, it experienced a 46 percent increase in this age cohort, where many of its competitors saw outright declines or small percent increases. No other of the top 10 metro areas in the country saw this kind of increase" [29, 3] and that "in fact, Atlanta has a net inflow of young adults from 44 of the 49 largest U.S. metros–with the greatest numbers coming from New York, Miami, Los Angeles, Chicago, Washington and Philadelphia" [29, 5].

However, does Atlanta–or any southern city–have a labor pool even remotely similar to that of Silicon Valley or Route 128?

Atlanta's labor pool does seem to be on par with that of other regions such as Austin and the Research Triangle; however, it is unlikely that it can match that of more successful clusters like Silicon Valley and Route 128 simply because their history and reputation do a lot to draw talented employees. Florida mentioned this pulling effect, referencing Pittsburgh and how even though it has Carnegie Mellon and the University of Pittsburgh and has been referred to as "America's Most Livable City," talented graduates from these universities are moving out of Pittsburgh, largely flocking to Silicon Valley and other "creative regions" [12, 218]. Florida's anecdote when considered along with the results of the Young and Restless study tells a positive story about Atlanta, however, since young people are generally flocking to it, not away from it.

5.3 Funding

Among O'Mara's lessons for those trying to build the "next Silicon Valley", she provides as her Lesson One: you need a lot of money. She states that "because venture capital went where the innovation was [. . .] at the close of the twentieth century the map of high-tech activity in the Unites States still bore a striking correspondence with the list of top university recipients of federal R&D in 1960" [31, 227].

Saxenian proposes that one reason Silicon Valley has seen more success in recent years than Route 128 is their difference in venture capital and its culture. She says that "Route 128 venture capital also lacked internal cohesion or strong ties to local industry. Studies of the venture capital industry document a greater degree of cross-fertalization and informal collaboration among West Coast venture capitalists than among those in Boston" [34, 65].

Feldman, on the other hand, suggests that the presence of supporting institutions such as venture capital plays a much lesser role in nascent clusters and instead tends

Table 4: Funding, Georgia and U.S.

Funding [4, 33]	**Georgia**	**U.S.**
Industry-performed R&D per $1,000 GSP	$5.33	$18.97
Federally-performed R&D expenditures per $1,000 GSP	$0.92	$1.49
University-performed R&D expenditures per $1,000 GSP	$3.13	$3.01
Venture capital disbursements, in millions	$561.8	$21,086.8
Small Business Investment Companies (SBIC) awards	468	19,472
Small Business Administration 7(a) business loans	1,498	1,345

to develop later on. Funding as a sign of a successful cluster will be discussed in Section 6.2.

As can be seen in Table 4, Georgia has been able to draw solid amounts of federally-performed and university-performed R&D expenditures–comparable to the national average–but is lacking in industry-performed R&D (see Table 4). Georgia is also lacking in SBIR awards [40, 41].

While Georgia has done fairly well at attracting venture capital investments, particularly for seed, start-up, and early stage as can be seen in Figure 4 and Figure 5, Georgia has few VC's of its own, and none of the fifty-five "most active venture investors" in 2007 are located in Georgia. For comparison, two are located in Texas (one in Austin and one in Dallas), one is located in North Carolina, and an astonishing twenty-seven are located in California and twelve in Massachusetts ([MoneyTree], 12). There are, however, some venture capitalists in Georgia, and they provide a source of investment deals both within Georgia as well as with companies in other states.

This lack of large, active venture capitalists in Georgia will be further discussed in section 5.4.

While Georgia has been successful at attracting venture capital investments for early stage companies, it has failed to maintain funding for later stage companies and has no renowned venture capitalists in-state. This is a major problem for the

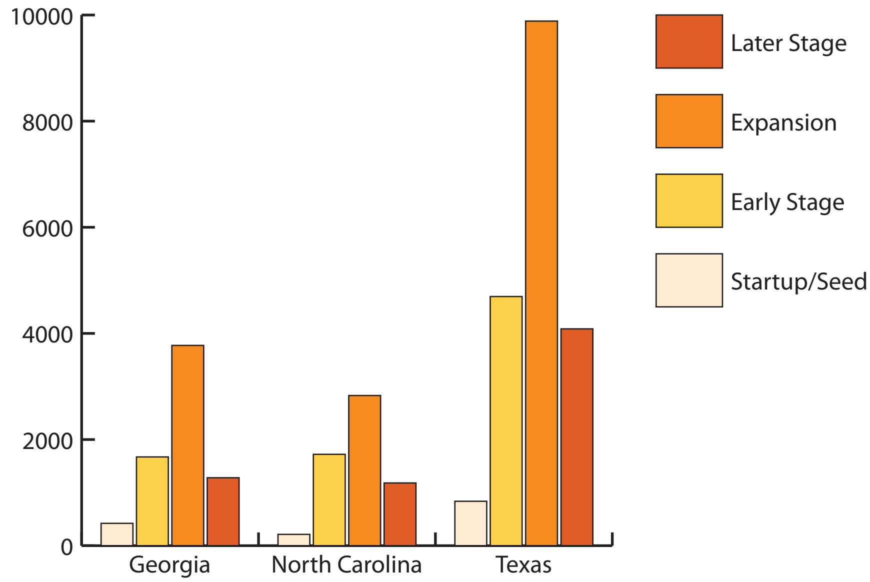

Figure 4: Venture capital investment by stage, millions of dollars, 1995–2005.

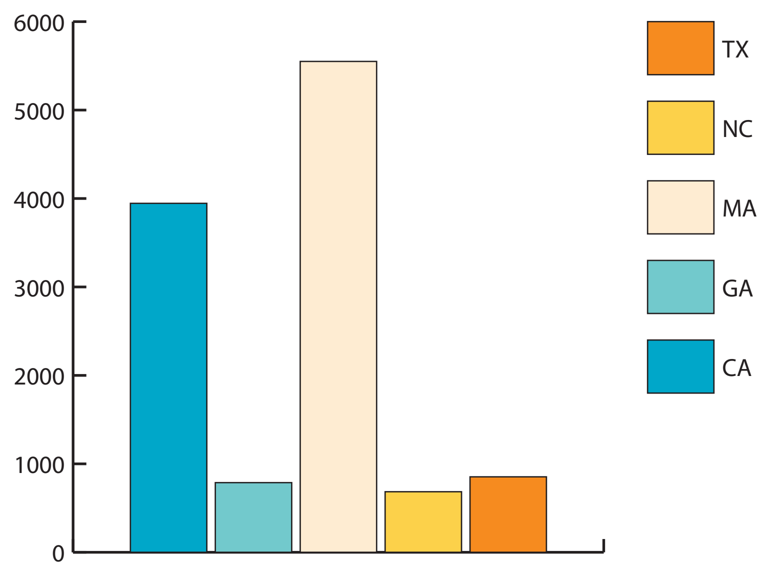

Figure 5: Total venture capital investment per capita.

growth of technology in Georgia since innovative technology companies need funding to survive and compete with companies in other regions.

5.4 Favorable Policies

There are many policies that scholars consider essential for building a cluster. They often regard very different aspects of cluster formation. In order to determine whether Atlanta has the appropriate policies, a variety of sources have been consulted, both to ascertain the necessary policies and to determine if Atlanta has implemented them.

Clinton, et. al. list sixteen policies they find necessary, and helpfully also provides data on which southern states have and do not have each of these policies.

Smilor's research of university spin-offs provides a list of policy recommendations that will help the creation and continuance of spin-offs: "Institutional mechanisms emerging in universities will help to accelerate new company development if they increase access to university personnel, ideas, consultants, and research expertise. Initiatives such as business incubators, centers for technology transfer, and research and science parks are likely to play an increasingly important role in generating spin-out companies. Efforts such as business angel networks, focused entrepreneurial educational programs, entrepreneurial courses with a hands-on emphasis, and continuing education programs focusing on the management and marketing needs of emerging companies would help to address the major difficulties facing spin-out companies" [35, 75].

The role of public policy in emerging clusters can be crucial. Carlsson outlines this in a chapter of *Cluster Genesis* (Braunerhjelm & Feldman), stating that "without a proper balance between institutional design and incentive design the probability of a successful emergence and evolution of cluster will diminish" [1, 11]. He also lists the functions of public policy as: ascertaining the existence of a sufficient knowledge base, creating transparent incentives, promoting entrepreneurial experiments, creating markets or guaranteeing appropriate market conditions, creating resources, and promoting positive externalities [1, 273-275]. This goes a long way in explaining how clusters can be promoted either before or after they begin to exist and can be helpful in providing policy prescriptions.

Feldman and Braunerjhelm's analysis of the "genesis of industrial clusters" [1] leads to many questions regarding clusters and cluster formation. They state that Silicon Valley was not an obvious location for the computer industry. If this is the case, why are there so many lists of factors that are thought to be necessary for a cluster to appear? Likewise, if Silicon Valley formed in this not-obvious manner, can a place intentionally be cluster-friendly? However, the article also says "the ingredients associated with Silicon Valley's success were not in place initially" [1, 1]. Perhaps it is possible for actors to help put these ingredients in place and thus encourage growth?

Favorable policies are arguably where Atlanta falls short of the requirements for the creation of a knowledge cluster. As can be seen in Figure 6, Georgia lacks tax incentives for angel investing, special tax treatment for IPOs or selling businesses, grants to new technology companies, an innovation strategic plan, and a telecommunications/technology plan. Even when compared only to the rest of the South, Georgia's policies and legislation are found lacking. For example, of the thirteen southern states, only Georgia and Tennessee do not have tax incentives for angel investing [3, 59].

These policies are necessary to encourage the growth of technology in Georgia, and definitely need to be reconsidered.

5.5 Linkages

Orsenigo includes "linkages with large firms and other industries" as one of his "ingredients of innovative clusters" [1, 205-206]. He also says that "knowledge resides in

Do legislation or policies exist enabling the following? [3, 59]	Georgia	South median
Do state employee pension plans invest in start-up companies?	**No**	**Yes**
Tax incentives for angel investing?	**No**	**Yes**
Special tax treatment for IPOs or selling businesses?	No	No
Special tax treatment for R&D equipment purchase?	Yes	Yes
R&D vouchers for research with universities	Yes	Yes
Special recruitment incentives for R&D facilities?	Yes	Yes
Special recruitment incentives for technology companies?	Yes	Yes
Entrepreneurial services?	Yes	Yes
Grants to new technology companies?	No	No
An innovation strategic plan?	**No**	**Yes**
A telecommunications/technology plan?	**No**	**Yes**
Support services for SBIR applicants?	Yes	Yes
Matching funds for SBIR grants?	**Yes**	**No**
Recruiting star university researchers?	Yes	Yes
Program for providing free college tuition?	Yes	Yes
Incentives for science and math teaching?	**No**	**Yes**

Figure 6: Georgia's legislation and policies.

the network and not simply in each of its constituent nodes" [1, 198].

When proposing his model of a technopolis wheel with seven segments (the research university, large technology companies, small technology companies, state government, local government, federal government, and support groups), Smilor states that certain individuals ("influencers") play an essential role by linking these segments together. He says that "indeed, unless the segments are linked in a synergistic way, then the development of the technopolis slows or stops" [36, 63]. As such, understanding the linkages and networks of a region can be helpful in analyzing the limits of its potential prosperity.

An anecdote by the editor of TechLINKS magazine, "the guide to technology in Georgia" perhaps sums up the strength of linkages in the technology sector in Georgia:

> At one point earlier this year, I had conducted an interview with a CIO of a major Georgia-based company. He was relatively new to his position (about 4-5 months), and he indicated having worked closely in a positive way with another CIO who is a friend to TechLINKS. When I passed along his kind words, the friend of TechLINKS thanked us and asked, "Has he

> landed a new job yet?"
>
> "Well, yeah!" I thought on impulse, as the information was obvious to me. At first, I found it odd that even though the two were friendly business acquaintances with a great deal of shared history, they were not current with even the most basic of information about each other.[18, 4]

Combes noted a lack of networks in Atlanta, but saw a positive side as well as a negative, saying

> The cooperative networks of firms that both compete and support each other, such as found in Silicon Valley, do not exist to the same degree in Atlanta. As a result, venture capitalists with intimate knowledge of the technologies and business environment underpinning new firms, are not as prevalent in Atlanta. Instead, public/private programs, such as the Advanced Technology Development Center, offer resources (but generally not funding) and moral support for new start-ups. As a result, Atlanta provides a business environment friendly to new firms, somewhat free of the rigid hierarchies of established firms impeding entrepreneurial endeavors, such as found in Route 128. [5, 257-258]

With regard to resources for high-tech development, only five of twenty Georgia economic developers interviewed "reported that their counties have at least one high tech or professional association. However, all of the developers reported to have at least one business networking association (e.g., local chamber of commerce, civic association, neighborhood association, etc.). [...] Many of the developers are connected to statewide networks" such as the Georgia Economic Developers Association [39, 44].

In order for Atlanta's linkages to be adequately analyzed, it will be necessary to gather and analyze data regarding social networks. This analysis deserves and will require separate research since it is more in-depth than a comprehensive analysis such as this can allow for. Anecdotally–at least–Atlanta lacks these linkages that theory states are so elemental.

5.6 City Characteristics

Several authors provide a variety of city characteristics that they believe are be essential for a cluster to form. Smilor (1989) mentions quality of life as being an important characteristic. O'Mara discusses social issues of a region such as racism, race relations, and inequality and the role they play.

Florida (2002) found that "rather than being driven exclusively by companies, economic growth was occurring in places that were tolerant, diverse, and open to creativity–because these were places where creative people of all types wanted to live" [12, x]. He also states that having "abundant high-quality amenities and experiences, an openness to diversity of all kinds, and above all else the opportunity to validate their identities as creative people" [12, 218] is the only way to draw a sufficient creative talent pool for a cluster to thrive.

As mentioned in Section 5.2, Atlanta scores well on the Young and Restless rankings. Atlanta is drawing in people age 25-34, an important age bracket that even Florida states as important. While this measure is not exactly the same as the ones Florida uses, it is quite similar and paints a positive picture of Atlanta drawing this young age bracket from cities across the nation.

Florida defines the creative class in two segments. The core is comprised of scientists and engineers, architects and designers, teachers and professors, artists, musicians, and entertainers whose economic function is to create new ideas, new technology, and/or new creative content. The segment around the core includes creative professionals in business and finance, law, health care, and related fields. He claims that this "creative class" values individuality, meritocracy, diversity, and openness.

Table 5: Overall state creativity ranking.

State	Overall Rank	Creativity Index
Massachusetts	1	188
California	2	184
Texas	5	163
Georgia	18	129
North Carolina	25	103

Table 6: Creative class and bohemian shares, by MSA.

Area	Creative Share	Bohemian Share
Atlanta, GA MSA	31.07%	1.29%
Austin-San Marcos, TX MSA	34.02%	1.48%
San Francisco-Oakland-San Jose, CA CMSA	36.07%	1.72%
San Francisco, CA PMSA	39.57%	2.73%
Raleigh-Durham-Chapel Hill, NC MSA	34.19%	1.23%
Boston-Worcester-Lawrence, MA-NH-ME-CT CMSA	30.39%	1.27%

He posits that human creativity is the driving force of changes in the social landscape between 1950 and 2000.

As can be seen in Table 6, Atlanta is slightly lower than the comparison regions in the share of its population that is considered to be in the "creative class." It also ranks lower than Austin and San Francisco on the "bohemian" proportion of its population. San Francisco, Austin, Boston, and Raleigh-Durham are all included in the top 10 creative class list of cities. Atlanta, however, does not make the top 10 list. When ranked by state, however, Georgia passes North Carolina (see Table 5). For large regions, Atlanta makes the top 10 in technology, talent, and tolerance, but not in creativity.

While Atlanta lacks on Florida's "creative class" index and other measures, the city as a whole looks promising, particularly the fact that Atlanta is attracting the "Young and Restless"–25- to 34-year-olds–from forty-four of the forty-nine largest U.S. metro areas.

5.7 Luck

Feldman & Braunerhjelm state that Silicon Valley was not an obvious location for the computer industry. Allen J. Scott also states that the location of Hollywood as a motion-picture cluster was somewhat arbitrary: there were many other regions that would have been equally appropriate, but when a new business model was invented in Southern California, and unfavorable policies in New York caused much of the industry to move out, Hollywood became the location of choice [1]. Bresnahan, Gambardella, and Saxenian directly refer to luck as a factor, stating that:

> There is a logical argument for suggesting that luck plays a role in this context. We noted that nascent clusters, and the entrepreneurs operating there, have to bet on new trajectories before they manifest their potential. But this also means that they have to bet on an opportunity before it is

A high-quality, powerful research university	PASS
A skilled labor pool	PASS
Funding (R&D, venture capital, etc.)	Questionable
Favorable policies	FAIL
Linkages	FAIL
City characteristics	PASS
Luck	Questionable

Figure 7: Required characteristics for clusters: Atlanta.

clear to everybody else that it is indeed an opportunity. Some degree of risk is therefore unavoidable. At the same time, this means that only some of these opportunities (and most likely few of them) will materialize. Many attempts at creating new clusters and successful new firms in certain industrial or technological trajectories will fail, and they will fail in spite of the fact that the key actors have done all the right things that are to be done in these contexts. In this area it appears that luck and skill are complements; those initiatives that embody a superior business model or technology are more likely to find the 'luck' they need [37, 845].

5.8 Summary

Atlanta seems to have achieved a passing grade on at least three of the seven necessary characteristics of cluster creation; however, Atlanta also has a failing grade on at least two of these (for a summary, see Figure 7). While Atlanta has a high-quality, powerful research university (albeit one that developed later than most), a skilled labor pool, and promising city characteristics, it is lacking policy even when compared to other southern states and is probably lacking essential linkages.

Whether Atlanta has adequate funding is questionable due to the unusual nature of venture capital investment in Atlanta. More research needs to be performed so that a greater understanding of the reasons behind high start-up venture capital and low later range venture capital can be gained.

CHAPTER VI

CHARACTERISTICS OF SUCCESSFUL CLUSTERS

Does a true technology cluster exist in Atlanta? A few measures of agglomeration, innovation, and success will be consulted in an attempt to determine the level of success Atlanta has seen in its attempts to become successful as a technology cluster.

6.1 Successful Companies

Successful companies show success of a cluster in general. If a region has a large number of successful companies in a particular industry or even a small number of highly successful companies in that industry, the region is more likely to be considered a cluster than if it does not.

Hecker created three levels of high technology industries that will be used throughout this section. Level I: technology-oriented occupations accounted for at least 5 times the average proportion (4.9%). Level II: 3.0 to 4.9 times the average. Level III: 2.0 to 2.9 times the average. Levels I and II can be seen in Figure 8. Level III contains mostly manufacturing firms, and as such is not relevant to this analysis.

6.1.1 Largest Successful Companies

A vast amount of the sales represented by Austin-San Marcos' MSA (as shown in Table 7) are the result of a single company. In fact, that single company accounted for $57,420,000,000 worth of Austin's total $70,947,564,217 sales (or 81%). That company is Dell, a Fortune 500 company and a major computer developer and manufacturer that was at one time the largest seller of personal computers and servers. Neither San Francisco nor Boston have a company quite as successful as the Austin area's Dell, however, both regions have at least one company listed in the D&B Million Dollar

NAICS	Industry [17, 60-61]
Level I (industries with at least 24.7% of their employment in high-tech occupations)	
3254	Pharmaceutical and medicine manufacturing
3341	Computer and peripheral equipment manufacturing
3342	Communications equipment manufacturing
3344	Semiconductor and other electronic component manufacturing
3345	Navigational, measuring, electromedical, and control instruments manufacturing
3364	Aerospace product and parts manufacturing
5112	Software publishers
5161	Internet publishing and broadcasting
5179	Other telecommunications
5181	Internet service providers and Web search portals
5182	Data processing, hosting, and related services
5413	Architectural, engineering, and related services
5415	Computer systems design and related services
5417	Scientific research-and-development services
Level II (industries with 14.8–24.7% of their employment in high-tech occupations)	
1131	Forestry
1132	Forestry
2111	Oil and gas extraction
2211	Electric power generation, transmission, and distribution
3251	Basic chemical manufacturing
3252	Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing
3332	Industrial machinery manufacturing
3333	Commercial and service industry machinery manufacturing
3343	Audio and video equipment manufacturing
3346	Manufacturing and reproducing, magnetic and optical media
4234	Professional and commercial equipment and supplies, merchant wholesalers
5416	Management, scientific, and technical consulting services

Figure 8: High-technology NAICS.

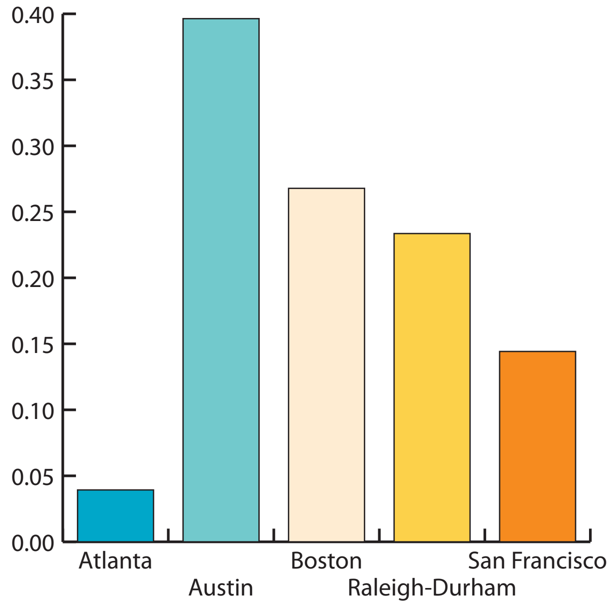

Figure 9: Level I technology companies with 500 or more employees, percent of total.

Database with sales exceeding 10 billion dollars.

In marked contrast to the Austin region, and quite different also than San Francisco and Boston, Atlanta's largest non-telecommunications technology company listed in the database has sales of a meager 1.1 billion dollars, and the Research Triangle's largest weighs in at 1.8 billion.

Also, Atlanta has far fewer companies with a large number of employees. According to the County Business Patterns released by the U.S. Census Bureau and using Hecker's definition of Level I technology companies, only 0.14% of Atlanta's companies have 500 or more employees. In comparison, in Austin, Boston, Raleigh-Durham, and San Francisco more than 0.45% of the total companies have 500 or more employees (Figure 9.)

Historically, Atlanta has been home to a few prestigious technology companies, most notably Scientific-Atlanta Inc., and MSA (Management Science America). Both, however, have since been purchased by companies that are not based in Georgia. MSA was founded in 1963 by five Georgia Tech graduates. Their first public offering was in 1981, and during the 1980s they were one of the largest software companies in the world. In 1990, they were purchased by Dun & Bradstreet for $333 million.

Scientific-Atlanta was founded in 1952 and has widely been considered a strongly significant part of the history of technology in Georgia. Many spin-offs from Scientific-Atlanta have appeared throughout the decades since it was founded. Similar to MSA, Scientific-Atlanta would not continue to be independently based in Georgia, and in 2006 it was acquired by the California-based Cisco Systems.

6.1.2 Small and Medium Companies

While large companies provide some benefits to a cluster or potential cluster, firms that are not as large also provide some benefits. In fact, Florida and Kenney state that small firms are even better suited to new high-technology than large firms [11]. Also an executive interviewed by Saxenian suggested that some of Silicon Valley's success at a time when Route 128 was performing poorly may have been attributable to the fact that Silicon Valley has a different structure and culture, leading it to have much smaller and more specialized companies than the large, vertically integrated companies present in Route 128. In an environment where large, vertically integrated companies are the norm, it is difficult for start-ups to thrive because they can find difficulty obtaining components or contract work they need [34, ix-xi].

As can be seen in Figure 10, Atlanta fares quite well on this metric, having proportionately more small companies than even San Francisco.

In order to gain an understanding of how many technology firms are in Atlanta and their general size, the County Business Patterns released by the U.S. Census Bureau were consulted. The results can be seen in Table 7 and Figure 12. Comparisons to the other technology clusters of Silicon Valley, Route 128, the Research Triangle, and Austin were made to provide for some interpretation of scale to the numbers. While

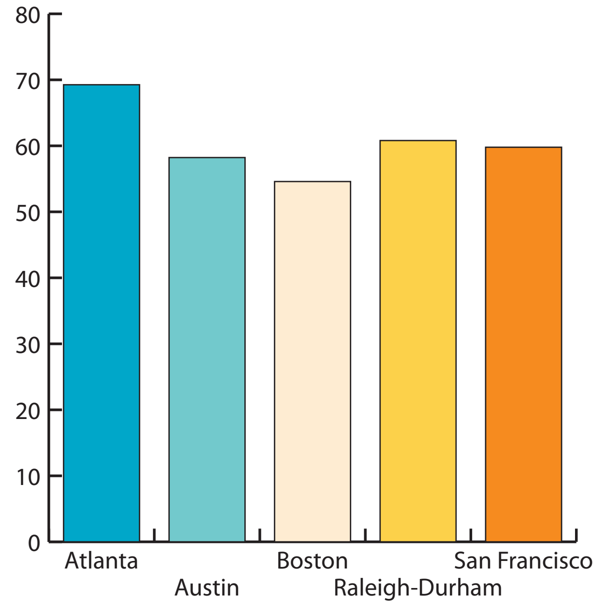

Figure 10: Level I technology companies with 1-4 employees, percent of total.

Atlanta has a similar number of technology companies (in both Level I and Level II) to the comparison regions (Figure 11), Atlanta has comparatively more employees in Level II companies and fewer in Level I companies. Also, Atlanta has a comparatively large number of Level II companies listed on the D&B Million Dollar database than other regions. This suggests that Atlanta's tech is not as "high" as the high-tech of other technology clusters. This figure also points out the commonality of smaller firms in Atlanta as previously mentioned. While Atlanta has a very similar number of technology companies to all the other regions, Atlanta has far a smaller proportion of its population employed in technology-intensive industries (see Figure 12).

Also, promising small companies are often bought out before they can become large and successful. This seems to be particularly true in Atlanta, and Combes noted that "the region's entrepreneurs who start firms often opt to sell out to larger, better established firms rather than growing their startup firms to more substantial size" [5, 10].

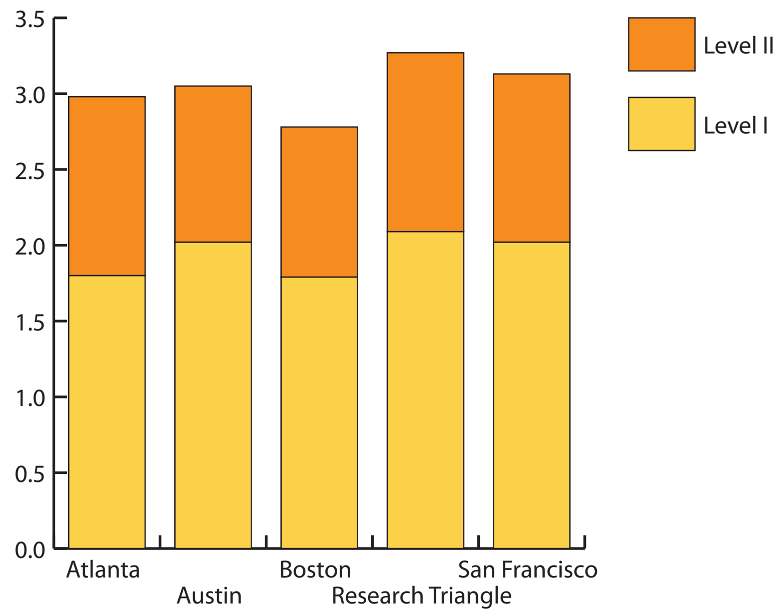

Figure 11: Level I and II companies per thousand people.

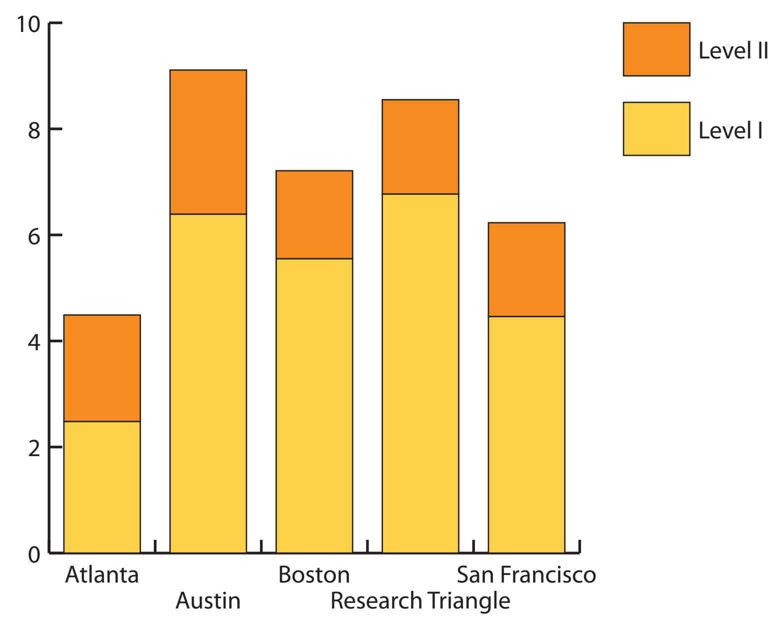

Figure 12: Employment in Level I and Level II industries, percent of population.

Table 7: Characteristics of high-technology MSA's.

	Atlanta	Austin	Boston	Raleigh-Durham	San Francisco
Descriptive					
Population (thousands)	4,248	1,250	4,391	1,224	4,124
Level I					
Companies	7,633	2,523	7,845	2,563	8,321
Employment (approx.)	105,192	79,935	243,754	82,913	183,928
Level II					
Companies	5,007	1,291	4,350	1,446	4,596
Employment (approx.)	85,478	33,991	72,876	21,758	72,798
Levels I & II					
Companies	12,640	3,814	12,195	4,009	12,917
Employment (approx.)	190,669	113,926	316,630	104,671	256,725
Patent Information					
Patents	1,045	1,571	3,805*	939	1,700*

6.1.3 Patents

In number of patents granted, Atlanta is clearly lagging as can be seen in Table 7. Only the smaller Research Triangle area is behind Atlanta in absolute number of patents. Atlanta comes in last of the five regions in terms of patents granted per capita and per technology company (Figure 13). This metric is not entirely accurate because patent data are only available for the pre-2000 MSA's, while company data are only available for the post-2000 MSA's. This probably explains much why San Francisco appears so low in patents. The post-2000 San Francisco MSA is much larger than the pre-2000 one. This graph is also not particularly accurate for Boston because the Boston patent data is only available for Boston's NECMA, not its MSA and thus is based on a larger region than the other figures in the table. The Atlanta, Austin, and Research Triangle data should be fairly accurate, however, as their MSA's did not suffer large changes when the lines were redrawn.

Atlanta has fewer patents per company than these regions. If any lack of confidence in the data remains, it is also important to note that even Atlanta's absolute number of patents is weak when compared with the smaller regions of Austin and the Research Triangle.

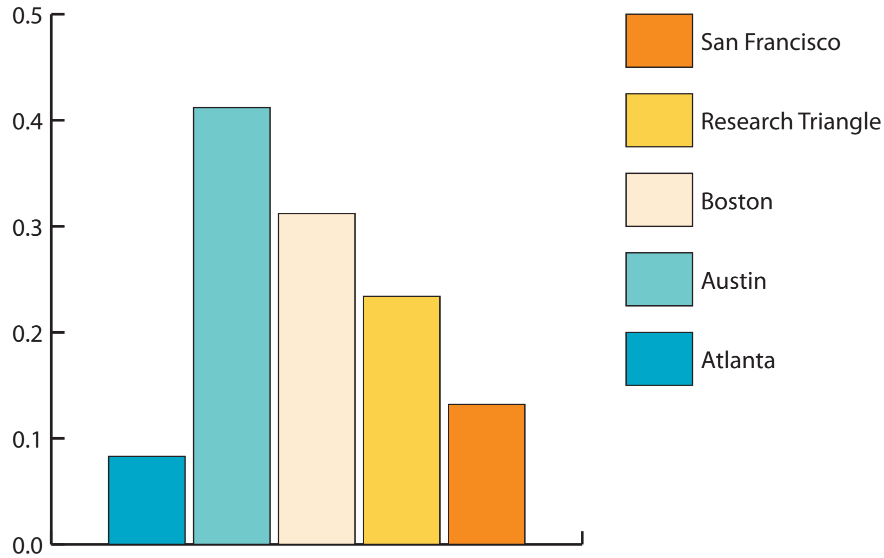

Figure 13: Patents per Level I and II technology company.

6.2 Funding

According to a Bureau of Labor Statistics article by Hecker, “A National Science Foundation report on science and technology resources also refers to the employment of scientists, engineers, and technicians and to measures of R&D activities as ‘two of the most important parameters of innovation’ and uses those two parameters ‘as surrogates for measuring the broader concept of innovation’” [17, 57].

While theory states that funding is a necessary characteristic for cluster formation, funding such as R&D and venture capital investment can also be considered a sign of success once a region is home to a particular industry cluster.

Since the data we have been able to gain access to are are only available for the current or very limited time period, there is no opportunity to perform a pre-cluster/post-cluster analysis of funding data and information. For a static look at funding in Atlanta, readers are advised to consult Section 5.3.

6.3 Employment (of scientists, engineers, and technicians)

Another important measurement of cluster success referred to by Hecker and others is employment. The measure of employment included in Table 7 refers to the total employment of companies in each MSA that are considered to be involved in a Level I or Level II high-technology industry (see Figure 8). When controlling for total population, Atlanta has far fewer employees in high-technology companies than any of the other four MSA's (see Figure 12).

6.4 Agglomeration

Perhaps the most important test in determining whether Atlanta is a cluster is measuring its level of agglomeration. The most commonly used analysis method for agglomeration is locational quotient. This simple technique is a ratio of a region's proportion of employment in an industry to the nation's proportion of employment in the same industry. If the value of the location quotient is larger than one, that region is considered a cluster in that industry because it is assumed that the region must export the products of the industry [19].

When calculated for Atlanta and the other comparison MSA's using County Business Patterns from the U.S. Census Bureau, it is found that Atlanta has a location quotient for Level I industries (defined in Figure 8) only slightly larger than one, and which is so close to one that it is within the margin of error (data in Table 8). Atlanta's location quotient is well below the location quotients of the comparison regions for Level I companies.

However, when Level II industries are analyzed, Atlanta has a location quotient that is greater than one and that is even larger than all of the comparison regions but Austin. This provides support for the observation made in Section 6.1.2 that it appears Atlanta's high-technology sector is not as "high-tech" as those of the other technology clusters.

Table 8: Location quotients.

Area	Level I	Level II	Levels I & II
Atlanta-Sandy Springs-Marietta	1.03	1.65	1.24
Austin-Round Rock	2.88	2.41	2.72
Boston-Cambridge-Quincy	2.25	1.32	1.94
Durham and Raleigh-Cary	2.81	1.45	2.35
San Francisco-Oakland-Fremont	2.02	1.57	1.87

6.5 Summary

It appears that Atlanta's performs poorly on all measures of successful clusters. Atlanta lacks successful companies, solid employment of scientists, engineers, and technicians, and has a fairly low location quotient for technology companies in general. While its location quotient does indicate that Atlanta is a cluster compared to the United States as a whole, it compares poorly to other technology-focused regions.

It is interesting to note that the two areas where Atlanta's performance is higher is in small companies (see Figure 10) and in Level II technology companies (Table 8). Atlanta's large number of small companies perhaps coincides with the observation made in Section 5.3 (Figure 4) that while venture capital investment in Georgia is low on the whole, Georgia has strong venture capital investment in start-up and seed companies. This observation requires further study in order to ascertain why small, new companies seem to fare better in Atlanta than large, old ones.

Likewise, the observation that Atlanta seems stronger in Level II than Level I technology companies links with the observation made in Section 6.1.2 noting that Atlanta has a greater number of Level II technology companies than the comparison regions.

CHAPTER VII

CONCLUSION

7.1 Summary of Findings

Is Atlanta an ideal location for a technology cluster to form? Currently Atlanta lacks some of the characteristics that theory lists as essential for a cluster to form. As outlined in Section 5.8, Atlanta lacks some appropriate policies as well as linkages and possibly also the infrastructure needed to encourage the formation of linkages. However, Atlanta does have many of the required characteristics, and it may be possible to improve its standing in the other areas through effective policies.

Does a true technology cluster exist in Atlanta? If a technology cluster exists in Atlanta at all, it is one more focused in manufacturing and the industries classified as Level II (see Figure 8), not the more technology-intensive Level I companies. It is also possible that a technology cluster is forming in Atlanta, but that it is still in its infancy. If policies are improved and better policies are enacted along the lines of the required characteristics for cluster formation outlined in theory, Atlanta will have improved its chances at becoming a strong technology cluster.

7.2 Interesting Observations that Deserve Future Research

One item worthy of note is the observation made in Section 6.1.2 and Section 6.4 (see Figure 12, Table 7, and Table 8), that the technology companies in Atlanta tend to be in industries that are focused on manufacturing more than in service industries and other technology industries that have a higher level of employment in high-technology occupations. This reveals the possibility that Atlanta is a different sort of technology cluster than those located in Silicon Valley or Route 128 or even than the Research

Triangle or Austin. Hopefully the details and ramifications of this observation will be examined more closely in future research.

Another interesting observation was made in Section 5.3 (see Figure 4) that Georgia is on-par or even better in terms of venture capital investment in start-ups when compared with North Carolina and Texas, however, Georgia is low in venture capital in later stage companies. A possible explanation for this is that many promising Georgia start-ups move out of state or are acquired by out-of-state companies before they fully develop. Some data and analysis thereof would be greatly beneficial at explaining both this phenomenon as well as the greater picture of the Georgia technology industry. One possibility for this analysis would be to look at VC deal data from the PricewaterhouseCoopers MoneyTree or other sources. A number of analyses could be performed with this data depending on the level of information accessible.

Another useful avenue for future research is performing social network analysis in order to assess the number and strengths of linkages. This analysis should involve the location of board members and investors so that it may also be used to help to explain the difference between start-ups and later stage firms in Georgia, depending on the results of the analysis. For example, if the venture capital firms that are investing in Atlanta's start-ups are located out-of-state they may choose to encourage the start-ups to move nearer to the VC or other firms the VC is investing in. If it is found through this analysis that VC's are indeed out of state, this research should be supplemented with case study or the research mentioned above regarding start-ups so as to more accurately pinpoint that as the cause or merely correlation due to other factors.

7.3 Policy Recommendations

If Atlanta does want to become a strong high-technology cluster, they need to improve their policies by improving their venture capital policies to be online with the rest of the United States and by providing tax incentives for angel investing at the very least. It also is advisable for Atlanta to provide infrastructure that can encourage the formation of linkages.

Atlanta officials also need to consider whether wish to consider growing and improving in Level II technology industries or whether they would prefer to instead or also focus on the more high-technology Level I industries. Infrastructure and planning should be based around this decision.

Also, O'Mara claims that state officials put too much emphasis on enhancing technology and science as an industry across Georgia, and instead should have focused more on building around the Atlanta area, particularly around the research universities within Atlanta. She states that this is necessary for an area to become a truly successful city of knowledge [31, 221-222]. As such, it may be advisable for policymakers to focus less on the state of Georgia as a whole and instead focus more specifically on the Atlanta area. A successful focus on the Atlanta area will probably lead to spillover benefits around the state, so this should not provide negative results, and if O'Mara is correct, it will foster the growth of Atlanta as a cluster.

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